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TO:	George Robin	**FAX NO:**	415-744-1873
FROM:	Kate Poole	**DATE:**	August 23, 2000
ENCLOSURE:	Errata to CURE's Comments on Draft UIC Permit for Elk Hills Power		
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August 23, 2000

George Robin
U.S. Environmental Protection Agency, Region IX
Ground Water Office, WTR-9
75 Hawthorne Street
San Francisco, CA 94105-3901

Re: Errata to CURE's Comments on the Draft UIC Permit for Elk Hills Power, LLC

Dear Mr. Robin:

On August 21, 2000, we submitted comments on behalf of the California Unions for Reliable Energy ("CURE") on EPA's proposal to issue an Underground Injection Control ("UIC") permit to Elk Hills Power, LLC for two Class I injection wells in the Elk Hills Oil Field. The attached errata makes some minor corrections to pages 11-13 of Dr. Fox's analysis, which was attached as Exhibit 1 to CURE's comments. The errata clarifies the calculations performed by Dr. Fox in order to make them more understandable.

The errata is attached in both redline/strikeout form, and in corrected form. Please replace the corrected pages of Dr. Fox's analysis for the original. Thank you for your assistance.

Sincerely,

Katherine S. Poole

KSP:
Attachments

1152a-210

Errata to Exhibit 1 of CURE'S Comments

Redline / Strikeout Form

downgradient and in the same aquifer as the injection zone. The modified Theis equation for this case is (Driscoll 1986, p. 771):

$$Q = Kb(h_w-H_o)/528 \log(r_o/r_w) \quad (1)$$

where

Q = injection rate in gpm = ~~438~~437.5 gpm (Eq 1) = 84,218 ft^3/day (Eq 2) (App., p. 23.)
K = hydraulic conductivity = 99.65 gpd/ft^2 (Eq 1) =13.3 ft/day(Eq 2) (App., p. 9)
b = aquifer thickness from top of Amnicola clay to bottom of Tulare clay = 1200 ft (Attach. 8, Sec. A-A')
h_w = head above the bottom of aquifer while inject~~recharg~~ing =1433 ft (Eq. 2)
H_o = head above bottom of aquifer when no inject~~pump~~ing is taking place = 1425 ft (Attach. 8, Sec. A-A')
r_o = radius of influence in feet
r_w = radius of injection well in feet = 0.36 ft (App., p. 17.)

The head above the bottom of the aquifer while ~~recharging~~ injecting was calculated from the following equation (Baumann 1965,[12] p. 239):

$$h_w = ~~a_o +~~ (a_o^2 - Q/\delta K[\ln(r_w/L) + 0.72])^{1/2} \quad (2)$$

where

a_o = initial depth of groundwater, from water table to top of Amnicola clay = 1,425 ft (Attach. 8, Sec. A-A').
$L = (10TKa_o)/i)^{1/2}$ = 78,127 ft (Baumann 1965)
i = porosity = 0.34 (App., p. 8.)
T = injection time = 10,950 days (30 yrs)

Substituting these values into Equation (2) yields the head above the bottom of the aquifer while injecting~~recharging~~, h_w, which is 1,433 feet. Therefore, injection would create a mount of wastewater in the vicinity of the injection well that is 8 feet above the original elevation of the water table or 1433 ft - 1425 ft = 8 ft. Solving Equation (1) for r_o, yields the radius of influence of 4,980 ft without considering dispersion. Dispersion may be accounted for using the Applicant's procedure (Warner and Lehr 1981, p. 112):

[12] Paul Baumann, Technical Development in Ground Water Recharge, Advances in Hydroscience, v. 2, 1965.

$$r_o' = r_o + 2.3(Dr_o)^{1/2} \quad (3)$$

where

D = dispersion coefficient = 65 ft (Warner and Lehr 1981, p. 112)
r_o' = radial distance of travel with dispersion.

Solving Equation (3) yields a radius of influence of 6,289 feet.

Thus, using the procedure recommended in 40 CFR 146.6 (a)(2), which accounts for local aquifer properties, yields a radius of influence (or "zone of endangering influence") that is substantially higher than the 950 feet to 0.5 miles assumed by the Applicant. This has three important consequences.

First, the injected wastewater would move beyond the boundary of the Elk Hills Oilfield, into nonexempt UDWSs south of the Oilfield. The southern extent of the wastewater plume would encompass the floodplain of Buena Vista Creek, which likely supports an alluvial aquifer that may be a UDWS.

Second, the zone of influence is large enough to encompass a large number of currently active oil production wells. (Application, Attach. 1.) These wells could serve as conduits that would allow injected wastewater to penetrate UDWSs.

Finally, the Application only reviewed information within the radius of review, which was selected as 0.5 miles. This analysis demonstrates that the area of review should have been at least 1.2 miles. This substantially expands the scope of the investigation that must be presented to support the UIC Application. For example, Attachment 1 shows that there are a number of additional abandoned wells within the 1.2 mile radius that were not included in the well review in Attachment 2. Therefore, the Applicant should be requested to update its Application to address this larger area of review.

Studies conducted in this area and cited by the Applicant suggest that injected wastewater from currently operating, nearby injection wells is currently moving out of the injection zone and adversely affecting local water quality. Benzene, which occurs at elevated concentrations in the currently injected produced water, has been found in the source wells within Section 18G. This study recommended that "a monitoring well be completed in the southeast corner of Section 18 G [where the proposed injection wells would be located] to determine if wastewater and the constituents associated with the wastewater are being sufficiently retarded in the exempt portions of the Tulare Formation and not

migrating towards adjacent non-exempt areas located to the southeast in Section 20G." (Bechtel 2/95,[13] p. 7-5.) It does not appear that the recommended well has been installed based on information provided by the Applicant in Attachments 1 and 2. Therefore, and in light of the foregoing, we recommend that EPA require one or more monitoring wells to evaluate whether injectate moves outside of the exempt aquifer.

Location of Wells

The draft permit reports the location of the wells in "Section 18, T.31 S., R.24 E, in Kern County, California." (Permit, p. 4.) Notwithstanding the above, this is not an adequate description to assure that injectate remains within the exempt portion of the aquifer. Given this description, these wells could be located anywhere within Section 18. If they were located near the southern boundary of the section, for example, the zone of influence, irrespective of the method used to determine the area of review, would extend into nonexempt portions of the aquifer. Therefore, the draft permit should be ~~reviewed~~ revised to specify the latitude and longitude of the proposed wells, as is customary.[14]

[13] Bechtel, NPR-1 Ground Water Protection Management Program, April 1994, Revised February 1995.

[14] See, for example, UIC Permit No. HI596002, issued to Puna Geothermal Venture.

Errata to Exhibit 1 of CURE'S Comments

Corrected Form

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